Housing and Husbandry of Laying Hens: past, present and future

H. A. Elson, ADAS Gleadthorpe, Meden Vale, Mansfield. UK

This review briefly traces the origins of the domestic fowl and its spread throughout the world. It goes on to consider important historic, traditional, conventional and modern developments in the housing and husbandry of laying hens. These periodic terms are used according to the definition of Gordon and Charles (2002) i.e. historic: pre 1914, traditional: 1918 to 1953, conventional: from 1953 to late 1990s. The modern era has been added to cover the most recent period i.e. during the turn from the second to the third millennium up to the present time, with a glimpse of the future. As commented 9 years ago, when reviewing half a century of the egg industry, “egg production has a long history but it is easier to look back forty years than to look forward ten!” (Elson, 2002).

Origins and spread

The progenitor of the domestic fowl was the Red Jungle Fowl (*Gallus gallus*), modern forms of which are found in Cambodia, India, Myanmar, Malaysia and Thailand. Crawford (1990) pointed out that one of the wild jungle fowl (Gallus domesticus) may have also contributed to the domestic fowl. These progenitors must have shared biological features, including aspects of behaviour, which predisposed them for domestication (Appleby *et al.*, 1992). It is believed that the fowl was first domesticated in Southeast Asia over 8000 years ago (Yamada, 1988) and established in China by about 6000 BC (West and Zhou, 1989). Its spread westward from Asia was documented by Crawford (1990): it eventually reached Europe, strongly influenced by the Roman Empire. During the earlier stages of domestication, the fowl was probably valued mainly as a sacrificial bird, or for cockfighting. It was the Romans who developed its potential for agriculture, creating specialised breeds (Thomson, 1964), including productive laying hens that formed a complex poultry industry (Wood-Gush, 1959). Pliny wrote that in Roman times there were birds laying an egg every day (Wood-Gush, 1971). With the decline of the Roman Empire the industry collapsed and did not resume on a large scale until the nineteenth century AD.

Development of an egg industry

Eggs now make a considerable contribution to animal protein in the human diet. Towards the end of the second millennium it was estimated that there were over 10 billion chickens in the world (FAO, 1990). There are few cultures that do not consume eggs in large quantities. Egg production in a variety of systems has grown to meet the increased demand.

Over the years, exchanges of scientific and technical information, increasingly on an international level, have greatly influenced the development of poultry systems. The World’s Poultry Science Association (WPSA) has been influential in encouraging research and development and in promoting its results worldwide. In particular Working Group 9 of the European Federation of WPSA (Poultry Welfare and Management), established in 1973, has had a positive effect on the study and development of greatly improved systems of egg production (Elson *et al.*, 2011).

In reviewing such developments reported in British Poultry Science over the past fifty years, Elson (2010) concluded that a variety of the findings of its papers have enlightened our understanding of many aspects of poultry housing and husbandry and thus led to improved performance. New techniques are often quickly implemented. In recent times bird welfare and environmental considerations have greatly affected legislation and egg production systems (Elson, 2002). The facilities and expertise required for egg production are now so specialised that the industry has become separated into distinct sectors. In developed countries there has been a progressive reduction in the number of producers and increase in unit size. Some egg companies have become vertically integrated to incorporate cereal production and feed preparation, stock multiplication, rearing, growing, egg production, processing and marketing (Appleby *et al.*, 1992). Several of these operate in more than

one country. Poultry breeding is now largely in the hands of multi-national companies. Marketing of eggs and their products takes place globally.

Historic period (before 1914)

Although its roots go back to Roman times, the egg industry really started during the nineteenth century. There is limited recorded information of developments during the centuries leading to the establishment of the egg industry, but some publications give glimpses of significant milestones in the UK.

Between the thirteenth and eighteenth centuries chickens seem to have been farmyard scavengers. In one thirteenth century manor the poultry were under the care of the dairywoman; each hen was "to answer for 115 eggs and 7 chickens" (Prothero, 1936). Rogers (1866) indicated that the number of fowl on eleven estates varied from 7 to 49 on each estate over the years 1333 – 1336, and their role in the economy was a very minor one. They were more important to the peasants and, in areas where coinage was short, were used to pay land rent. However, with the advent of the nineteenth century, poultry farming was advocated as a specialised enterprise on an increased scale.

During this period breed societies appeared and poultry clubs were formed all over Britain (Charles, 2002). This stimulated the establishment of breed standards and poultry stock improvement. Some of these clubs, e.g. the Sussex Club, concentrated on maintaining breed characteristics. Others, e.g. the Utility Poultry Club (UPC), carried out trials to improve performance aimed at achieving high fecundity and stamina.

The Complete Farmer made a plea for the development of poultry farming along scientific lines (Anonymous, 1807). Subsequently, a few large poultry establishments came into existence (Wood-Gush, 1959). By the late 1800s there was a thriving egg industry in France, described at that time as the egg factory of the world, and many eggs were imported into England until larger units were established in the UK.

Traditional period (1918 – 1953)

Until this time egg production took place mainly on general farms as small or farmyard flocks or at a few specialised establishments with larger flocks.

This new period was characterised by considerable progress in the mainly land based egg industry, interrupted by World War II. In the early stages egg production was based on small flocks of hens kept outdoors on mixed farms alongside other livestock and crop enterprises.

Various aspects of the history of the rapid growth of egg production and the development of housing systems in the UK during this period have been the subject of many accounts published over the past 25 years e.g. by Hewson (1986); Telford *et al.* (1986); Appleby, Hughes and Elson (1992); Crawford (1995); Whittle (1998) and Charles (2002).

After World War I egg production became a popular occupation for returning troops looking for an outdoor country life. Eggs were scarce and prices high, especially in winter due to seasonal production, so despite high feed costs due to shortages following the war and moderate efficiency, margins were considerable from well managed flocks (Robinson, 1961). Thus small specialist laying flocks grew rapidly, mainly kept on permanent pasture. The egg industry grew considerably in importance during the inter-war years; when the WPSA (founded in London in 1912 as the International Association of Poultry Instructors and renamed WPSA in 1928 – Hann, 1996) met at Crystal Palace in 1930 it was opened by the Duke of York and attended by almost 100,000 visitors!

By 1933 there were almost 70 million poultry in the UK (MAF, 1934). Similar expansion also took place in other parts of Europe e.g. the Netherlands; the French egg industry was already well established, having started earlier. However, during the 1930's there were numerous challenges e.g. egg prices slumped and mortality greatly increased to over 20%. The problems encountered included 'fowl sick' land, salmonella pullorum, red and scaly leg mite, coccidiosis, worms, comb frostbite, crop binding and losses to predators (Elson, 1988); these were associated with the extensive systems

used and caused the high mortality (Robinson, 1961). Egg output suffered and many egg producers left the industry.

The **free range** (FR) system was quite different then from what is called FR today. Laying hens were kept on well drained hard wearing nutritious pasture at low stocking densities (about 250 birds/ha) either in small mobile houses with slatted floors, usually arranged in rows that were moved frequently (often weekly) across the field (image 1), or in small enclosures called fold units. The latter consisted of a small house with an attached covered run; they were also usually in rows and were moved daily (image 2). In both variations the hens normally used the house only for roosting at night and nesting during the morning; they did, of course, also take limited shelter there in inclement weather. Fold units also afforded some protection from predators. Feed, grit and water were always provided outside in these extensive systems. The hens were often mixed with sheep to achieve better grazing and land management. Robinson (1961) quoted estimates of feed savings of up to 10% by hens grazing on good quality fresh young grass.

Image 1. Traditional free-range houses

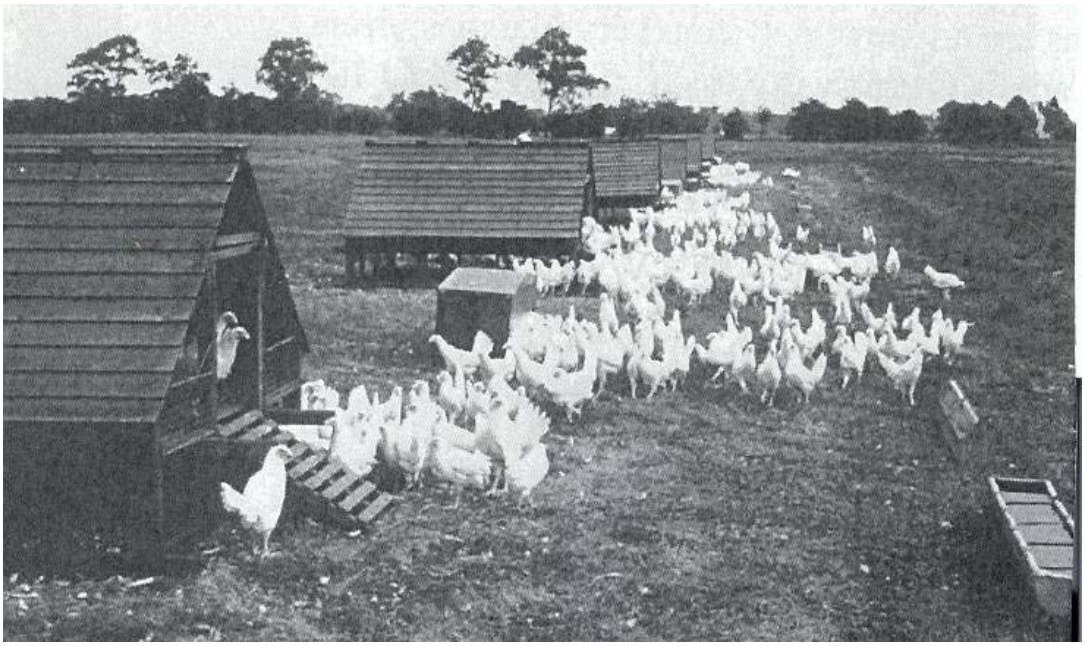
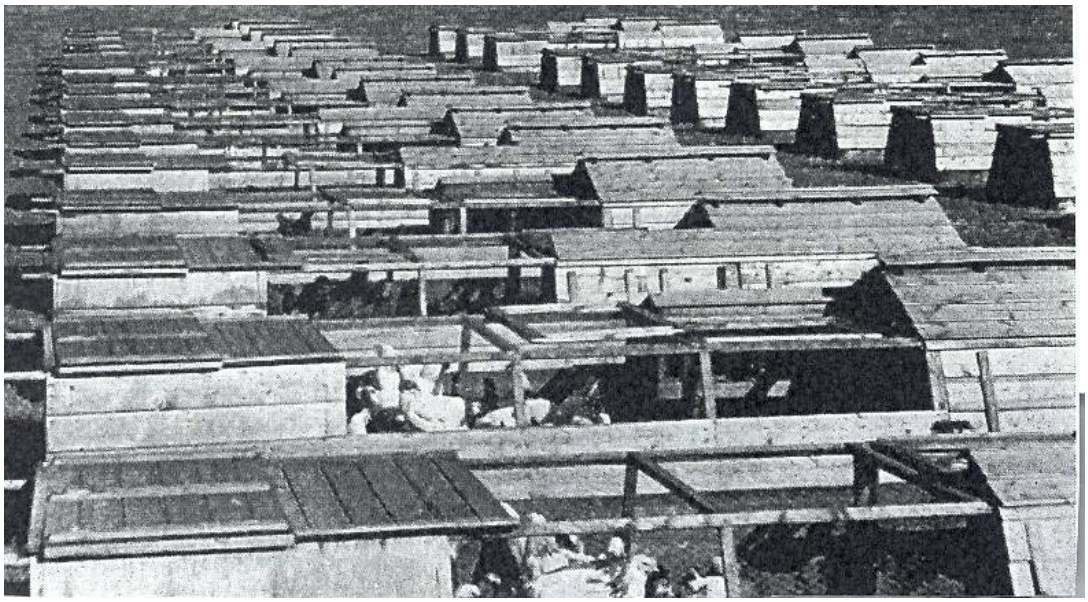


Image 2. Rows of fold units on range



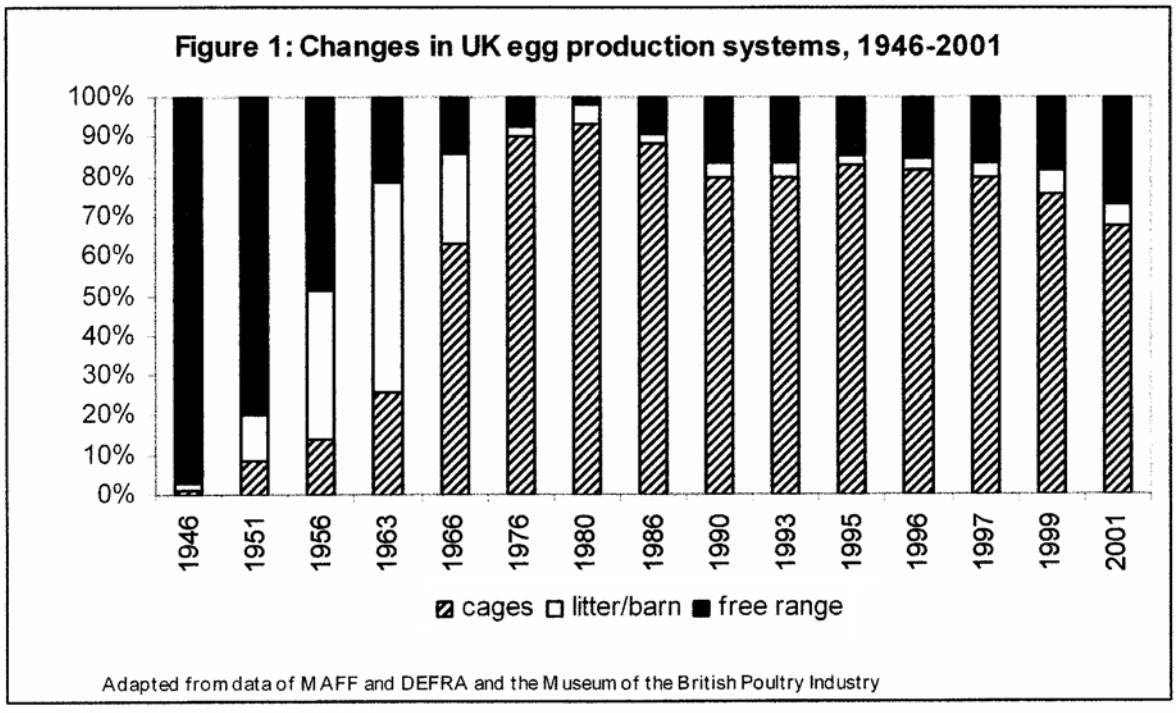
The **semi-intensive system** (SI) became popular with egg producers and pullet rearers from about 1925 onwards. It was more akin to what is currently called FR, had a higher stocking density of up to about 750 hens/ha and consisted of fixed houses with alternate grassed pens used in rotation. The houses allowed hens more space than FR ones so that birds could spend more time inside especially in winter. Feed was sometimes provided inside but there was always at least a daily 'scratch feed' of grain outside.

An important discovery was the **value of lighting** for egg production. Although not practiced much because it was difficult to apply in small FR houses, it became known in the mid-1920s that extending day length by artificial light to stop it diminishing after mid-summer increased egg output in the autumn and winter months; this was thought then to be due to extended days allowing birds more time to eat (Fairbanks and Rice, 1924). This was effective for the few that tried it, using oil lamps, but would not come into its own till later when the subject was better understood (Morris and Fox, 1958) and intensive housing took over and made it easier to apply.

The **war years brought great changes**. Egg production was severely affected by feed rationing, which reduced both the quality and quantity of feed available. General farmers survived best because they had home-grown cereals available (Robinson, 1961). Many producers left the industry, the number of laying hens kept fell drastically, egg production declined and production systems remained much as they were before the war. This situation continued for a few years after the war, although the move into intensive housing systems started in the late 1940s.

Conventional period (1953 to late 1900s)

1953 was a key turning point in the development of the poultry industry. Poultry feed rationing came to an end in the UK (Whittle, 1998), which allowed expansion of the industry in size and technical efficiency in response to consumer demand for cheaper and more abundant supplies of eggs. Writing in 1954, Coles noted that in the USA 90% of laying hens were kept intensively, mainly on deep litter; the figure for Britain at that time was 35% (about half of them in cages and the other half on deep litter) and rose rapidly to 90% in cages by 1966 and a peak of 95% in cages in1980 about 4% still being on deep litter - see figure 1 - (Elson, 2002).



2007: cages 62%, barn 4%, free range 34%.

The above references to deep litter would appear to indicate a system that came and went within about 30 years. If well managed, the system had several benefits (Goode, 1957) but was quickly overtaken by cages, which are better suited to large-scale economic egg production. Certain elements of the deep litter system were incorporated into barn housing, often used in conjunction with the modern FR system that came into use during the 1980s (Elson, 2004).

Animal Machines (Harrison, 1964) and the Brambell Report (1965) drew attention to the need to protect the welfare of livestock kept under intensive systems. The 'battery' laying cage was the focus of debate, which led to much research and development to improve its design and management and that of various alternative husbandry systems for laying hens (Elson, 1989). European legislation to protect laying hen welfare followed (CEC, 1988) and further influenced the conditions under which eggs were produced (Appleby *et al.*, 1992).

The world energy crisis of 1974 focussed attention on feed conversion efficiency and led to the conservation of bird heat to maintain house temperature during winter, more efficient mechanised feeding and minimisation of waste. Meanwhile, intensive methods of poultry husbandry dominated the scene in most developed countries until the 1980s when, as a result of the welfare debate and the development of a niche market, FR laying hens were re-introduced in Britain and some other northern European countries, initially on a small scale. These developments could be seen as moves back from intensive production towards land based ecological approaches, more integrated with sustainable agriculture.

Modern period (1990 to the present)

This period has been characterised by increasing concerns over animal welfare, pollution of the environment, global warming and the serious threat of infectious diseases e.g. Avian Influenza (AI). Each of these concerns has influenced developments in both the intensive and extensive sectors of the egg industry.

An important effect of poultry welfare legislation was to reduce stocking density (SD). Thus more space was required in conventional cages and they are to be phased out by 2012. Furnished (enriched) cages (FCs) were conceived when the welfare deficiencies of barren conventional ones were realised. Their forerunner was the 'get-away' cage, designed by Elson (1976) to provide hens with perches and nest boxes in an enlarged space. Its development led on to two new concepts: multi-tier aviaries (see image 3) and FCs (Elson, 1988). The use of FCs was intended to enhance hens' behavioural repertoire and welfare without the disadvantages of non-cage and extensive housing. They have an even lower SD than modern conventional cages plus nest boxes, perches and litter (CEC, 1999).

Image 3. Multi-tier aviary

The design of FCs has been gradually refined, resulting in much improved performance and welfare. Group size has been an important consideration, especially in relation to variation in damaging pecking in differing genotypes with or without beak treatment. The trend has been to move from small groups of 8 to 10 hens, used mainly in Scandinavia (image 4), to much larger 'colony' cages (FCLs) for groups of up to 90 hens – see image 5 (Elson and Tauson, 2011).

Large scale studies, in which performance and welfare have been compared across all currently available systems, enable us to conclude that with good management they are at least as good in FCs as in any other system, and probably superior (Elson and Croxall, 2006; Sherwin *et.al.*, 2010). A special design of FCL providing greater height and space, Kleingruppenhaltung, has been introduced in Germany and the Netherlands.

The trend towards non-cage (NC) and extensive production continues at the expense of intensive methods, but organic egg production remains a niche product. Most modern FR houses are fixed and even mobile ones are usually fairly large, and only moved about once a year. Feed and water are provided inside the house, the outside feeding of the traditional period now being unacceptable because it attracts wild birds, rodents and predators. Modern FR houses are also much larger than traditional ones, and have more space (maximum SD 9 hens/m² - CEC, 1999). Efficient multi-tier aviary housing is increasingly being used in NCs and as the housing part of FR systems.

Image 4. **Small furnished cage (FCS) for 8 hens**

Image 5. **Large furnished cage (FCL) for 60 hens**

The effect of the above factors is to discourage hens from leaving the house; those birds that do range are often only outside for short periods and may stay near the building. Large pop-holes are now used, and trees planted or other structures added to provide shelter and shade to encourage birds out and across the range (image 6). The downside of this is that increased mortality due to smothering and/or predation is more likely.

Image 6. Modern free-range farm

The future

CEC (1999) requires the demise of all conventional cages in the EU by 2012, and has accelerated the move into FCs and NCs; this is likely to continue over the next few years. The use of FCs has also begun to spread beyond Europe; a few recent installations have been made in the USA, where agreement has recently been reached between industry and welfare institutions that they should be accepted as meeting legislative requirements to replace conventional laying cages by 2025 (United Egg Producers, 2011). Further worldwide spread is likely.

FCs have potential for further improvement especially in terms of cage and group size, litter and lighting provision, the development of a technique to blunt beaks and redirect pecking away from feathers and catching and handling during depopulation (Elson and Tauson, 2011). Adequate litter provision to satisfy hens' ethological needs, including dust-bathing, needs further research and development. This may require greater area and depth of litter as well as frequent litter replenishment.

NCs, especially FR systems, are vulnerable to increased welfare challenges because hens going outside are exposed to greater risks of infectious disease, endoparasitic infestation, smothering and predation, which can result in much higher mortality (Elson, 2008). Energy use and the carbon footprint are also higher in extensive systems. Housing system design and management will therefore require close attention.

Meerpohl (2009), asked to consider likely developments in poultry keeping over the next 25 years, suggested that “We are not going to experience any spectacular new methods of poultry husbandry but will undoubtedly see continuous further developments and improvements of existing systems that, in the end, are certainly going to surprise us”. One such innovative development may be the Dutch **Rondeel NC system**, which incorporates new ideas and technology; it has yet to be perfected but opens up new possibilities including a combination of indoor and limited covered outdoor FR (Niekerk, 2011). If accepted as FR in the same way that the semi-intensive system was in the 1980s, the Rondeel could prove to be a big advance on current FR and as efficient as modern FCLs.

Zusammenfassung

Managementsysteme für die Haltung von Legehennen: Vergangenheit, Gegenwart und Zukunft

Der Autor beschreibt die Entwicklung von Haltungssystemen für Legehennen von der Antike bis in die Gegenwart und stellt dabei folgende Zeitabschnitte heraus: Anfänge vor dem Ersten Weltkrieg, die "traditionelle" Haltung bis in die 1950er Jahre, die "konventionelle" (Effizienz-betonte) Haltung bis etwa 1990 und die "moderne" (zunehmend Tierschutz-betonte) Haltung in den letzten 20 Jahren. Bei der Weiterentwicklung von Haltungssystemen dürften Ressourcen (Futterverwertung, Energie)- schonende Produktion und minimale Umweltbelastung ebenso an Bedeutung gewinnen wie die Akzeptanz seitens der jeweiligen Gesellschaft - wobei Überraschungen nicht auszuschließen sind.

References

Anonymous (1807). The Complete Farmer or General Dictionary of Agriculture and Husbandry. Rider and Wead. London.

Appleby, M.C., Hughes, B.O. and Elson, H.A. (1992). Poultry Production Systems: Behaviour, Management and Welfare. CAB International.

Brambell, F.W.R. (1965). Report of the Technical Committee to Enquire into the Welfare of Animals kept under Intensive Livestock Husbandry Systems. Command Paper 2836. HMSO. London.

CEC. (1988). Council Directive 88/166/EEC laying down minimum standards for the protection of laying hens kept in battery cages. Official Journal of the European Communities. L74.

CEC. (1999). Council Directive 99/74/EC laying down minimum standards for the protection of laying hens. Official Journal of the European Communities. L 203.

Charles, D.R. (2002). Food, farming and the countryside: past, present and future. Nottingham University Press.

Coles, R. (1954). Changes in the pattern of poultry keeping. Journal of the Royal Agricultural Society of England 115: 69-82.

Crawford, R.D. (1990). Origin and history of poultry species - chapter 1 in Poultry Breeding and Genetics. Elsevier Science Publishers. Amsterdam.

Crawford, R.D. (1995). Origin, History and Distribution of Commercial Poultry – chapter 1 in World Animal Science Series: Poultry Production. Elsevier Science BV. Amsterdam.

Elson, A. (2002). Half a century of egg production - 1962 to 2012. Poultry International 41(5): 8-16.

Elson, A. (2004). The laying hen: systems of egg production. Proc. WPSA 27th Poultry Science Symposium on the Welfare of the Laying hen. Bristol pp. 67-80. CAB International Publishing, Wallingford.

Elson, A. (2008). Do extensive poultry systems really offer superior welfare? Poultry International 47(3):10-14.

Elson, H.A. (1976). New ideas on laying cage design-the “Get-away” cage. Proc. 5th European Poultry Conference. Malta. 1030-1041.

Elson, H.A. (1988). Poultry management systems - looking to the future. World’s Poultry Science Journal 44: 103-111.

Elson, H.A. (1989). Improvements in alternative systems of egg production. Proc. 3rd European Symposium on Poultry Welfare. Tours. 183-199.

Elson, H.A. (2010). Poultry housing and husbandry. British Poultry Science. 51: 23-34.

Elson, H.A. and Croxall, R.A. (2006). European study on the comparative welfare of laying hens in cage and non-cage systems. European Poultry Science 70: 194-198.

Elson, H.A. and Tauson, R. (2011). Furnished cages for laying hens. In: Alternative Systems for Poultry – Health, Welfare and Productivity. CABI Oxford.

Fairbanks, F.L. and Rice, J.E. (1924). Artificial illumination of poultry houses for winter egg production. Cornell Extension Bulletin 90.

FAO (1990). FAO Production Yearbook. Vol. 44. Food and Agriculture Organisation of the United Nations. Rome.

FAWC. (1997). Report on the Welfare of Laying Hens. Tolworth.

Gordon, S.H. and Charles, D.R. (2002). Niche and Organic Chicken Products: their technology and scientific principles. Nottingham University Press.

Hann, C.M. (1996). A brief history of the World's Poultry Science Association. In: UK Branch 50th Anniversary. WPSA UK Branch.

Harrison, R. (1964). Animal Machines. Stuart. London.

Hewson, P.F.S. (1986). Origin and development of the British poultry industry: the first hundred years. British Poultry Science 27: 525-540.

MAF. (1934). Returns from Agricultural Holdings in England, Wales and Scotland.

Meerpohl, B. (2009). Keeping poultry in the future. World Poultry. 25(6). 14-15.

Ministry of Agriculture and Fisheries data in Robinson, L. (1961) p.2.

Morris, T.R. and Fox, S. (1958). Artificial light and sexual maturity in the fowl. Nature 181:1522-1523.

Niekerk, Th.G.C.M. (2011). [Insert Title & page nos.] Lohmann Information. 46 (2):

Prothero, R.E. (1936). English farming past and present. 1961 edition. Heinemann and Frank Cass and Co. London, first published 1912.

Robinson, L. (1961). Modern Poultry Husbandry. Crosby Lockwood. London.

Sherwin, C.M, Richards, G.J. and Nicol, C.J. (2010). Comparison of the welfare of layer hens in four housing systems in the UK British Poultry Science. 51: 488-499.

Telford, M.E., Holroyd, P. and Wells, R.W. (1986). History of the National Institute of Poultry Husbandry, Nuffield Press.

Thomson, A.L. (1964). A New Dictionary of Birds. Nelson. London.

United Egg Producers. (2011). Historic agreement hatched to set National Standard for nation's egg industry. www.unitedegg.org/homeNews/UEP_Press_Release_7-7-11.pdf

West, B. and Zhou, B. (1989). Did chickens go north? New evidence for domestication. World's Poultry Science Journal 45: 205-218.

Whittle, T.E. (1998). A Triumph of Science: a 70 year History of the UK Poultry Industry. Poultry World Supplement.

Wood-Gush, D.G.M. (1959). A History of the Domestic Chicken from Antiquity to the 19th Century. Poultry Science 38: 321-326.

Wood-Gush, D.G.M. (1971). The Behaviour of the Domestic Fowl. Heinemann. London.

Yamada, Y. (1988). The contribution of poultry science to society. World's Poultry Science Journal 44: 172-178.

Author's address:

arnold.elson@adas.co.uk